

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

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## PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY  
(PCT Rule 43bis.1)

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No  
PCT/EP2004/052154

International filing date (day/month/year)  
13.09.2004

Priority date (day/month/year)  
18.09.2003

International Patent Classification (IPC) or both national classification and IPC  
G06T17/20

Applicant  
POLITECNICO DI MILANO

1 This opinion contains indications relating to the following items:

- ☒ Box No I Basis of the opinion
- ☐ Box No II Priority
- ☐ Box No III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No IV Lack of unity of invention
- ☒ Box No V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No VI Certain documents cited
- ☐ Box No VII Certain defects in the international application
- ☐ Box No VIII Certain observations on the international application

2 **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66 1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220

3 For further details, see notes to Form PCT/ISA/220

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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**International application No.  
PCT/EP2004/052154

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**Box No. I Basis of the opinion**

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1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material:
    - ☐ in written format
    - ☐ in computer readable form
  - c. time of filing/furnishing:
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in computer readable form.
    - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/EP2004/052154

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**Box No. V Reasoned statement under Rule 43b/s.1(a)(i) with regard to novelty, inventive step or  
Industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-13
	No: Claims	
Inventive step (IS)	Yes: Claims	1-13
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-13
	No: Claims	

**2 Citations and explanations**

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Reference is made to the following document:**

D1: ZAO H.-K., OSHER S. AND FEDKIW R., "Fast Surface Reconstruction Using Level Set Method", Proceedings of the 2001 IEEE Workshop on Variational and Level Set Methods, 13-07-2001

**2. CLAIMS 1-13**

**2.1 Claim 1**

**2.1.1 Novelty**

Document D1 is regarded as being the closest prior art to the subject-matter of Claim 1 and discloses (the references in parentheses applying to this document):

A method for determining the three-dimensional surface of an object from a set of sample points characterised in that:

The surface is determined from a set of scattered points based on a variational level set formulation (section 1).

The subject-matter of claim 1 differs from this known method in that the volumetric function  $F$  is iteratively calculated for each cell that have not been initially preset through the following formula:

$$F(x_i, t+1) = [ F(x_i, t) \cdot v_i + w \cdot \sum_j (F(x_j, t) \cdot v_j) ] / [ v_i + w \cdot \sum_j v_j ]$$

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

**2.1.2 Inventive step**

The problem to be solved by the present invention may be regarded as how to retrieve accurately the geometry of a surface from a set of points located on that surface.

The solution to this problem proposed in claim of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: The use of a level set methodology whereby the evolution of the volume function is driven by the evolution of two fluids of opposite mass is considered as providing an improved method for determining in a fast and accurate way the surface of an object from a scattered set of points located on the surface of said object.

**2.2 Claims 12 and 13**

The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent computer program claims 12 and 13, which therefore are also considered new and inventive in the sense of Article 33(2) and 33(3) PCT.

**2.3 Claims 2-11**

Claims 2-11 are dependent on Claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.